Review paper

Predicting the futuristic trend for 6 years in India for rice yield and rainfall

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Abstract: Rainfall plays a very important role in influencing the climate, agriculture and increasing the groundwater levels. It is a biggest factor in determining the atmosphere of a certain place. Coming to India, Rice is an important staple food and highly depends on rainfall. Thus, it is a must to know the futuristic trends of rice and rainfall. This paper focuses on predicting the futuristic trend values for yield of rice and rainfall in India from 2020 to 2025 and finding the existing yield and rainfall for years 2015 to 2019 using trend analysis.

Keywords: Rice, rainfall, trend, analysis

1.Introduction

Rain is fluid water as beads have consolidated from climatic water fume and afterward become substantial enough to fall under gravity. Rain is a significant segment of the water cycle and is liable for keeping the vast majority of the new water on the Earth. It gives appropriate conditions to numerous kinds of biological systems, just as water for hydroelectric force plants and harvest water system.

The significant reason for rain creation is dampness moving along three-dimensional zones of temperature and dampness contrasts known as climate fronts. On the off chance that enough dampness and upward movement is available, precipitation tumbles from convective mists (those with solid upward vertical movement, for example, cumulonimbus (thunder mists) which can arrange into thin rain groups. In rocky regions, substantial precipitation is conceivable where upslope stream is augmented inside windward sides of the landscape at height which powers sodden air to gather and drop out as precipitation at the edges of mountains. On the leeward side of mountains, desert atmospheres can exist because of the dry air brought about by down slant stream which causes warming and drying of the air mass. The development of the storm trough, or intertropical combination zone, carries stormy seasons to savannah climes. Atmosphere is one of the fundamental determinants of rural creation. Environmental change is any adjustment in atmosphere after some time that is credited straightforwardly or in a roundabout way to human movement that modifies the organization of worldwide air notwithstanding normal atmosphere inconstancy saw over practically identical timespans (IPCC, 2007). Since climatic variables fill in as immediate contributions to horticulture, any change in climatic elements will undoubtedly significantly affect crop yields and creation. Studies have demonstrated a noteworthy impact of progress in climatic factors on the normal harvest yield (Dinar et al. (1998), Seo and Mendelsohn (2008) and Cline (2007). Throughout the world there is critical worry about the impacts of environmental change and its inconstancy on farming creation. Analysts and executives are worried about the potential harms and advantages that may emerge in future from environmental change impacts on farming, since these will influence household and universal arrangements, exchanging design, asset use and food security. Horticulture regularly assumes a bigger job in creating economies than in the created world. For instance, horticulture in India makes up generally 20% of GDP and gives about 52% of business (when contrasted with 1% of GDP and 2% of work for the US), with most of rural specialists drawn from more unfortunate fragments of the populace (FAO, 2006). Besides, it is sensible to expect that ranchers in creating nations might be less ready to adjust to environmental change because of credit limitations or less access to adjustment innovation. Numerous investigations in the past have demonstrated that India is probably going to observe one of the most elevated rural profitability misfortunes on the planet as per the environmental change design watched and situations anticipated. Environmental switch projections made up to 2100 for India demonstrate a general increment in temperature by 2-4oC with no significant change in precipitation amount (Kavikumar, 2010). Studies by IARI and others demonstrate more prominent expected misfortune in Rabi crop. Each 1oC ascent in temperature diminishes wheat creation by 4-5 million tones. Fluctuation in storm precipitation and temperature changes inside a season. Worldwide reports show lost 10-40% in crop creation. Change in temperature and moistness may change the populace elements of pathogens. Lower yields from dairy cows, decrease in fish reproducing, movement and harvests are the outcomes of environmental change.

Rice is the seed of the grass species Oryza sativa (Asian rice) or Oryza glaberrima (African rice). As an oat grain, it is the most generally devoured staple nourishment for an enormous piece of the world's human populace, particularly in Asia. It is the farming ware with the third-most noteworthy overall creation (rice, 741.5 million tons in 2014), after sugarcane (1.9 billion tons) and maize (1.0 billion tonnes).[1]Since

sizable segments of sugarcane and maize crops are utilized for purposes other than human utilization, rice is the most significant grain as to human nourishment and caloric admission, giving more than one-fifth of the calories devoured worldwide by humans.[2] There are numerous assortments of rice and culinary inclinations will in general shift regionally. Rice, a monocot, is ordinarily developed as a yearly plant, in spite of the fact that in tropical regions it can make due as a perpetual and can deliver a ratoon crop for up to 30 years.[3] Rice development is appropriate to nations and locales with low work expenses and high precipitation, as it is work escalated to develop and requires abundant water. Be that as it may, rice can be developed essentially anyplace, even on a precarious slope or mountain region with the utilization of water-controlling patio frameworks. In spite of the fact that its parent species are local to Asia and certain pieces of Africa, hundreds of years of exchange and exportation have made it typical in numerous societies around the world.

Rice is fundamentally developed in rain taken care of zones that get overwhelming yearly precipitation. That is the reason it is in a general sense a kharif crop in India. It requests temperature of around 25 degree Celsius or more and precipitation of in excess of 100 cm.

Figure 1: Rice

2.Methodology

The yield of rice and the annual rainfall data in India has been collected. The data is tabulated. The existing trend for 5 years 2015-2019 and the futuristic trend for 6 years 2020-2025 is been found using the method of least squares.

3.Data used

The data used for trend analysis is secondary data. No changes are made to the yield of rice data collected from the reference website. The annual rainfall for each state in India is given in the reference website. An average of the data is considered to be the annual rainfall of India

Table 1: Converted Data which is going to be used

Rice		Rainfall	
Year	**Yield (in 1000 MT)**	**Year**	**Rainfall (in mm)**
2004	83127	**2004**	1323.5
2005	91785.00	**2005**	1431.653
2006	93345.00	**2006**	1364.869
2007	96682.00	**2007**	1465.281
2008	99172.00	**2008**	1347.447
2009	89083.00	**2009**	1191.039
2010	95970	**2010**	1485.642
2011	105301	**2011**	1387.106
2012	105241	**2012**	1272.586
2013	106646	**2013**	1486.717

4.Procedure

Predicting the futuristic trend for Rainfall and yield of rice for 6 years using the method of Least squares:

4.1. Trend for Rice yield

Table 2: Method of least squares for rice

Year	Y(Yield(In 1000MT))	X	X^2	XY	Y^t=a+bX
2004	83127	-5	25	-415635	**87214**
2005	91785.00	-4	16	-367140	**89222.57**
2006	93345.00	-3	9	-280035	**91231.14**
2007	96682.00	-2	4	-193364	**93239.71**
2008	99172.00	-1	1	-99172	**95248.28**
2009	89083.00	0	0	0	**97256.85**
2010	95970	1	1	95970	**99265.42**
2011	105301	2	4	210602	**101274**
2012	105241	3	9	315723	**103282.6**
2013	106646	4	16	426584	**105291.1**
2014	105482	5	25	527410	**107299.7**
Total	1071834	0	110	220943	

Using the necessary formula for finding the values of a and b, we get
a=97256.85
b=2008.57
Substituting in the trend formula, we get the trend value for the years from 2004 to 2014.
Below is the estimated existing yield for the years 2015-2019

Table 3: Existing years trend estimated values

Year	Trend
2015	109308.3
2016	111316.8
2017	113325.4
2018	115334
2019	117342.6

Here is the trend predicted for the years 2020-2025

Table 4: Predicted trend value for 6 years

Year	Trend
2020	119351.1
2021	121359.7
2022	123368.3
2023	125376.8
2024	127385.4
2025	129394

Note: The above provided trend data is not exact. It is just approximate. The actual yield will be plus or minus 500 for the given trend.

From the above chart we can infer that there is linear increase in the trend. The difference between the actual and the trend value is less but they are not equal. Thus, we have a margin of plus or minus 500 the trend value.

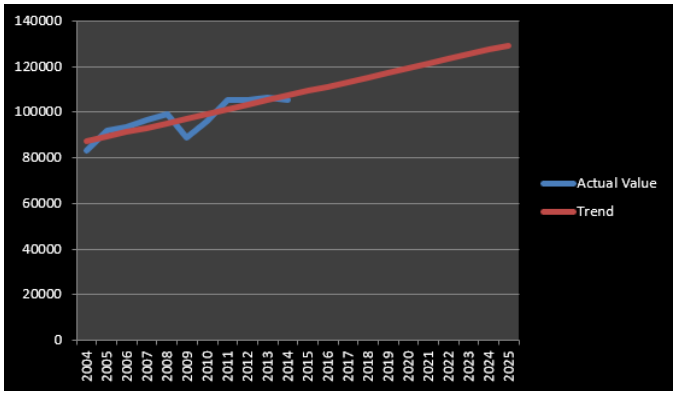

Figure 2. Actual and trend value of rice yield

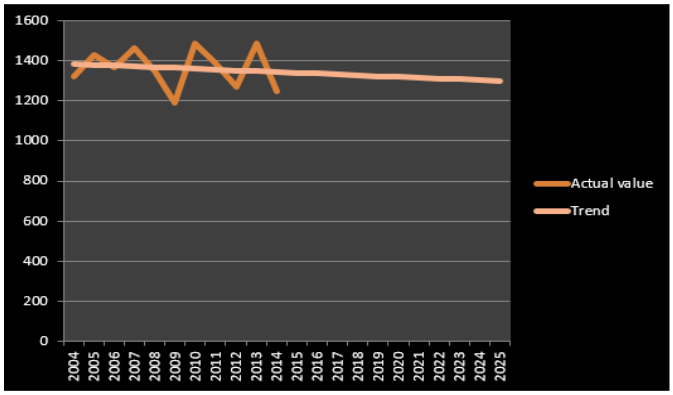

Figure 3. Actual and trend value of the rainfall in India

4.2 Trend for Rainfall

Table 5: Method of least squares for Rainfall

Year	Y(Rainfall(In mm))	X	X^2	XY	Y^t=a+bX
2004	1323.5	-5	25	-6617.5	1384.81
2005	1431.653	-4	16	-5726.61	1380.732
2006	1364.869	-3	9	-4094.61	1376.654
2007	1465.281	-2	4	-2930.56	1372.576
2008	1347.447	-1	1	-1347.45	1368.498
2009	1191.039	0	0	0	1364.42
2010	1485.642	1	1	1485.642	1360.342
2011	1387.106	2	4	2774.212	1356.264
2012	1272.586	3	9	3817.758	1352.186
2013	1486.717	4	16	5946.868	1348.108
2014	1248.722	5	25	6243.61	1344.03
Total	15004.56	0	110	-448.638	

Using the necessary formula for finding the values of a and b, we get

a=1364.42

b= - 4.078

Substituting in the trend formula, we get the trend value for the years from 2004 to 2014.

Below is the estimated existing yield for the years 2015-2019

Table 6: Existing years trend estimated values

Year	Trend
2015	1339.952
2016	1335.874
2017	1331.796
2018	1327.718
2019	1323.64

Here is the trend predicted for the years 2020-2025

Table 7: Predicted trend value for 6 years.

Year	Trend
2020	1319.562
2021	1315.484
2022	1311.406
2023	1307.328
2024	1303.25
2025	1299.172

Note: The above provided trend data is not exact. It is just approximate. The actual yield will be plus or minus 300 for the given trend.

From the above chart we can infer that there is linear decrease in the trend. The difference between the actual and the trend value is less but they are not equal. Thus, we have a margin of plus or minus 300 the trend value. If the same situation continues there may be very less rainfall in the future.

5.Declarations

- Study limitations: None
- Funding source: None
- Competing Interest: None

6. Conclusion

Food plays a great part in developing the immune system of any living being on earth. Rice being the steamed staple food of Asia is supposed to be very health because it is oil free and full of nutrients. An adequate amount of rainfall results in good production the crop. From the above trend we can find that the trend line of rainfall is decreasing and that of the rice is increasing. But we know that the production of rice depends on rainfall. Form the above data we can infer that if rainfall decreases, the rice production will decrease, if rainfall is good rice production will be good. If this trend of rainfall continues then we will not have enough production of food for the growing population. Afforestation and finding ways to decrease the increasing global warming is the only way to increase the rain.

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